

A REVIEW OF THE LINYPHIID SPIDER GENUS *SOLENYSA* (ARANEAE, LINYPHIIDAE)

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ABSTRACT. The present paper gives a review of the *Solenysa* spiders. Five of the six known *Solenysa* species were examined, including the types of *S. longqiensis*, *S. wulingensis* and *S. circularis*. Illustrations of these five species as well as diagnoses and distributional data of all species are provided.

Keywords: Taxonomy, Asia, China, Korea, Japan, spiders, ant mimicry

The linyphiid spider genus *Solenysa* was established by Simon (1894) for the sole species *Solenysa melloteei* Simon 1894 from Japan. *Solenysa* remained as a monotypic genus until five additional species were described from China and Korea during the 1990s, including *S. longqiensis* Li & Song 1992, *S. wulingensis* Li & Song 1992, *S. circularis* Gao et al. 1993, *S. protrudens* Gao et al. 1993 and *S. geumoensis* Seo 1996.

Members of the genus appear to be ant mimics and have the posterior part of the carapace drawn into a tubular extension reminiscent of the constricted waist of ants. Further, the epigynum of the females is connected to the abdomen by a long, transparent tube or solenoid. A similar structure is found in some other linyphiids such as *Wubanooides* Eskov 1986 from the Palearctic region (Tanasevitch 1996: figs. 7–9) and *Metalephyphantes* Locket 1968 from Africa (Locket 1968: figs. 27, 33).

This paper reviews the genus *Solenysa*. Type specimens of *S. longqiensis*, *S. wulingensis*, *S. circularis* and fresh specimens of *S. protrudens* and *S. melloteei* have been examined and illustrated. Further diagnoses and distributional data of all six known species are provided.

METHODS

Specimens were examined and measured using an SZ11-Olympus stereomicroscope. Further details were studied under an Olympus BX40 compound microscope. All illustra-

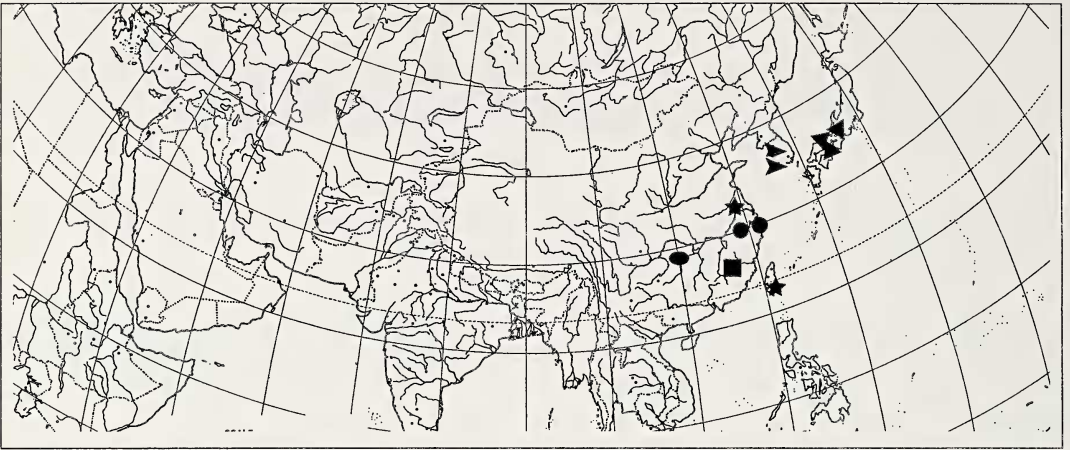
tions were made using a drawing tube and inked on ink jet plotter paper. Male palps and female epigyna were examined and illustrated after they were dissected from the spider's bodies. Vulvae of female epigyna were cleared in boiling KOH solution to dissolve non-chitinous tissue, and the embolic divisions of male palps were excised by breaking the column (the membranous connection between the suprategulum and the radix). For examination of the genital structures under transmitted light microscopy, male palps and epigyna were immersed in 75% alcohol solution, while embolic divisions and vulvae were mounted in Hoyer's Solution.

For each species, the synonyms are taken verbatim from Platnick's spider catalogue (Platnick 2003). Updated information about the distribution of each species in China is provided at the provincial level. The names of localities and distribution data are given according to current Chinese standard (see Peng et al. 2003).

All measurements are in millimeters. Terminology for the somatic morphology and genital structures follow Hormiga (2002). The abbreviations used as follows:

Somatic morphology: AER = anterior eye row; ALE = anterior lateral eye; AME = anterior median eye; AME-ALE = distance between AME and ALE; AME-AME = distance between AMEs; AMEd = diameter of AME; PER = posterior eye row; PLE = posterior lateral eye; PME = posterior median eye; PMEd = diameter of PME; PME-PLE = distance between PME and PLE; PME-PME = distance between PMEs.

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Map 1.—Distribution of *Solenysa* spiders. Circles = *S. circularis* Gao et al.; arrowhead = *S. geumoensis* Seo; square = *S. longqiensis* Li & Song; triangles = *S. melloteei* Simon; star = *S. protrudens* Gao et al.; and ellipse = *S. wulingensis* Li & Song.

Male palp: DSA = distal suprategular apophysis; E = embolus; EM = embolic membrane; LC = lamella characteristic; P = paracymbium; PCA = proximal cymbial apophysis; R = radix; SPT = suprategulum; T = tegulum; TA = terminal apophysis; TS = terminal sclerite.

Epigynum: CD = copulatory duct; CO = copulatory opening; FD = fertilization duct; S = spermatheca; SL = solenoid.

The specimens studied here are deposited in the Institute of Zoology, Chinese Academy of Sciences in Beijing (IZCAS), and in Jilin University, Changchun, China (JLU, formerly called Norman Bethune University of Medical Science).

TAXONOMY

Family Linyphiidae Blackwall 1859

Solenysa Simon 1894

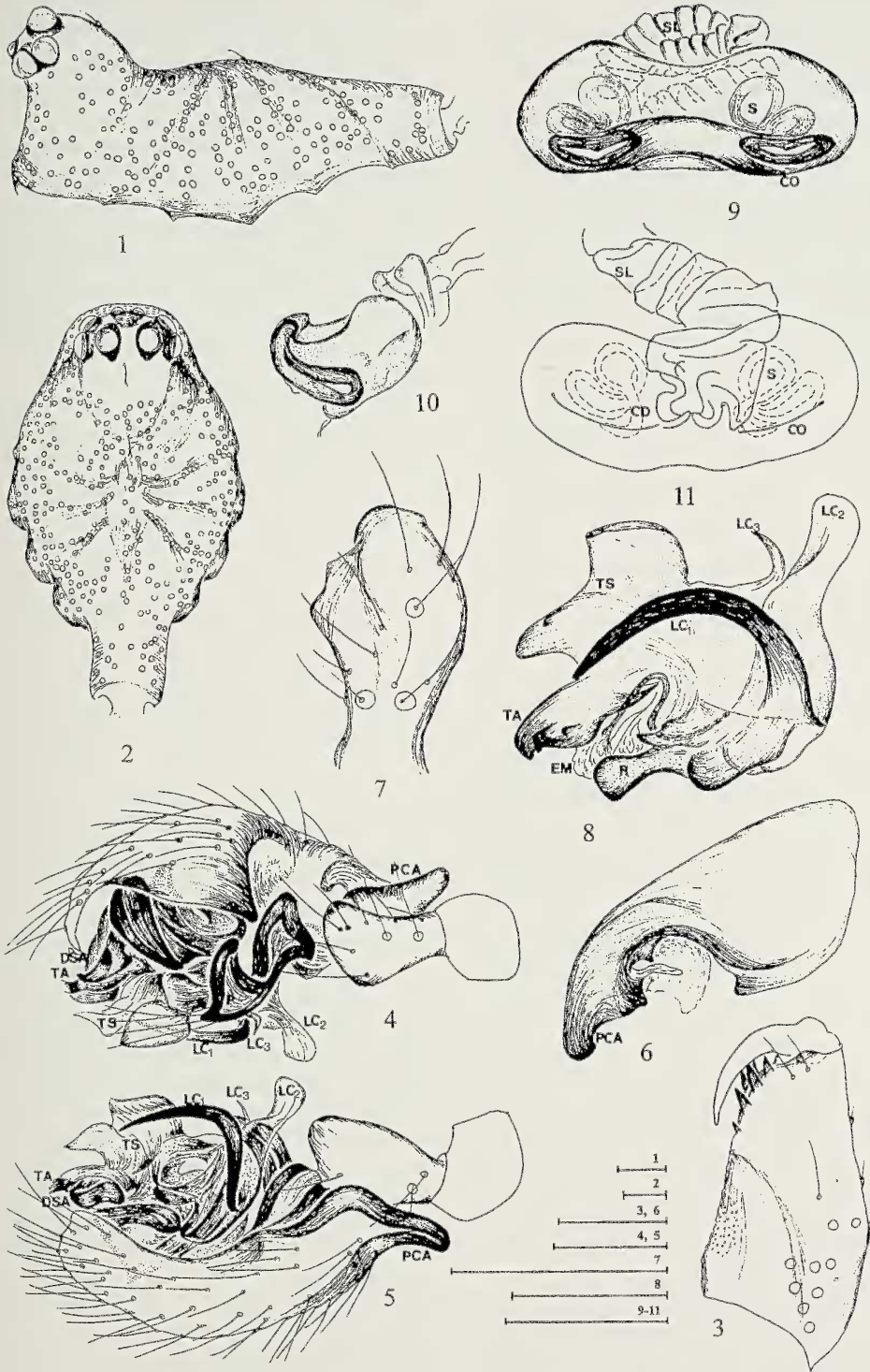
Solenysa Simon 1894: 677.

Type species.—*Solenysa melloteei* Simon 1894, by monotypy.

Diagnosis.—*Solenysa* species can be distinguished from other linyphiids by their very small body size (total length 1.11–1.70) and their unique body appearance; especially by the tubular extension of the posterior end of the carapace and by the many impressed, round pits scattered all over the carapace (Figs. 1, 2). Cymbium usually with one or two large proximal apophyses (Fig. 4). Paracymbium L-shaped. Lamella characteristic well

developed, divided in two or three branches. Epigyne protruding well sclerotized connected to the abdomen by a long, transversally wrinkled, membranous solenoid base, which is packed between the epigynum and abdomen in the nonfunctional stage (Fig. 9).

Description.—Small spiders, total length of males 1.11–1.61, females 1.27–1.70. Both sexes similar in general appearance with little interspecific variation. Carapace chestnut-brown, with numerous impressed, round pits; fine radial striae little darker in color. Carapace in dorsal view elongated oval, slightly constricted at level of cervical groove; sides behind cervical groove distinctly crenate, with four lobes beside coxae; posterior part of carapace drawn into tubular extension (Fig. 22); cephalic region turret-like bearing AMEs in front, PMEs at top, ALEs and PLEs on its lateral sides (Fig. 1). AMEs black and very small, their diameter about half of others', rest of eyes subequal; AER recurved, AME-AME almost equal to AMEd and AME-ALE longer, PER almost straight, PME-PME equal to PMEd and PME-PLE shorter, ALE and PLE juxtaposed. Clypeus broad, concave immediately below ocular area, sloping in convex line towards frontal margin. Chelicerae slightly lighter in color than carapace, with some round pits frontally and some granules anterolaterally; promargin with 4 and retromargin with 2–4 teeth; lateral sides with distinct stridulating ridges. Sternum darker in color than carapace, roundish heart-shaped, with many



Figures 1-11.—*Solenysa circularis* Gao et al. 1. carapace, lateral view; 2. carapace, dorsal view; 3. right chelicera, anterior view; 4. left male palp, retrolateral view; 5. left male palp, prolateral view; 6. left male palpal cymbium, dorsal view; 7. right palpal tibia, dorsal view; 8. left male palpal embolus division, dorsal view; 9. epigynum, ventral view; 10. epigynum, lateral view; 11. vulva, dorsal view. Scale bars = 0.1 mm.

granules, each carrying long hair. Legs long and slender; tibia I–IV and patella I–IV with a dorsal spine shorter than diameter of tibia. Tm I 0.17–0.26. Tm IV absent.

Male pedipalp: Tibia with one prolateral and two retrolateral trichobothria (Fig. 17). Cymbium normally with one or two large, proximal apophyses, outstanding in retrolateral view (Fig. 4), except in *S. wulingensis* and *S. geumoensis* (Fig. 43). Paracymbium small, L-shaped, furnished with several long apical hairs, deeply curved and with torsion at its middle. Tegulum triangular in retrolateral view (Fig. 4). Distal suprategular apophysis large and well sclerotized. Shape of embolic membrane variable. Lamella characteristica conspicuously large, normally with two or three branches, at least two of them well developed (Fig. 8): the first sword-shaped or spike-like, strongly sclerotized, the second ribbon-like and the third variable in shape or even missing (Fig. 18). Terminal apophysis strongly sclerotized, usually with 1–3 teeth. ‘Terminal sclerite’ located in membranous region between radix and lamella, continuous with base of lamella, varying in shape and appearance.

Epigynum: Protruding and well sclerotized, variable in shape, connected with abdomen by long, transversally amply wrinkled, membranous solenoid base, which in nonfunctional stage is folded between epigynum and abdomen.

Remarks.—The members of the genus *Solenysa* seem to be ant mimics and have the posterior part of their carapace drawn into a tubular extension resembling the waist of ants. Further, the epigynum of the females is connected to the abdomen by a long solenoid base. Similar structures are found e.g. in *Wubanooides* Eskov 1986 (Tanasevitch 1996: figs. 7–9) and *Metalephyphantes* Locket 1968 (Locket 1968: figs. 27 & 33). However, *Solenysa* can be easily distinguished from all other linyphiid genera by its unique appearance as described above.

Distribution.—China, Korea and Japan (Map 1). Specimens can be found amongst grass, leaf-litter and other detritus, but are very rare in museum collections.

Solenysa circularis Gao et al. 1993

Figs. 1–11

Solenysa circularis Gao et al. 1993: 66, figs. 7–10;

Song et al. 1999: 204, figs. 116H–I, N–O.

Material examined.—CHINA: Zhejiang: Mt. Tianmushan (30.4°N, 119.5°E), female holotype and 1 male paratype (JLU); Mt. Putuoshan (30.0°N, 122.4°E), 1 female paratype (JLU).

Diagnosis.—The male of *S. circularis* is easily recognized by the cone-shaped, posteriorly directed cymbial apophysis (Fig. 4) and by the conspicuous, curved spike-like branch of lamella characteristica in prolateral view (Figs. 5, 8). The epigynum of the female (Fig. 9) is similar to that of *S. protrudens* (Fig. 38), but is more rounded and distinctly bulging laterally.

Description.—Total length 1.27. Carapace 0.73 long, 0.44 wide. Abdomen 0.57 long, 0.43 wide. Tm I 0.26. Tm IV absent. Chelicerae with 4 promarginal and 2 retromarginal teeth (Fig. 3). For further measurements and a detailed description of somatic morphology see Gao, Zhu & Sha (1993).

Male palp (Figs. 4–8): Lamella characteristica tripartite (Fig. 8); the first branch biggest, curved spike-like, well sclerotized, second one short and blunt, and third one smallest, falciform. Terminal apophysis with two small apical processes at its dorsal side: one truncate, one coniform. Terminal sclerite large, foliaceous, bipartite. Embolus and embolic membrane shortest among the five species described in this paper, even shorter than terminal apophysis. Anterior part of radix drawn into handle-like extension.

Epigynum (Figs. 9–11): Wider than long, sides rounded, posterodorsal part in lateral view turned anteriorly; solenoid base partly visible (Fig. 9), 3 times as long as the length of epigynum, twisting anteriorly and connected with its dorsally side.

Distribution.—Known only from the original localities in Zhejiang Province, China (Map 1).

Solenysa geumoensis Seo 1996

Solenysa melloteei Namkung 1986: 13, figs. 6–10 (misidentification).

Solenysa geumoensis Seo, 1996: 157; Namkung 2002: 182, figs. 17.35a–b.

Material examined.—None.

Diagnosis.—Judging from the illustrations by Namkung (1986, 2002), the male of *S. geumoensis* is close to that of *S. wulingensis* as both have cymbium without outstanding proximal apophysis (Namkung 1986, fig. 9) and in

prolateral view basically similar lamella characteristic (Namkung 1986, fig. 8). They differ in that one branch (exactly which one is not clear) of the lamella characteristic of *S. geumoensis* has a forked tip (Namkung 1986, fig. 7) while *S. wulingensis* has all branches entire (Fig. 46). Furthermore, the apical portion of the paracymbium of *S. geumoensis* is longer than that of *S. wulingensis* (Namkung 1986, fig. 7). Epigynum half round shape, posterior part wider than anterior part, the transparent vulval structures convergent anteriorly (Namkung 1986, fig. 10).

Description.—See Namkung (1986, 2002).

Distribution.—Korea (Map 1).

Remarks.—*Solenysa geumoensis* is thought to be written by Seo in 1996, but the original description on this species is not easy to obtain. A further study on this species will be necessary in future, in case that we can get the types or fresh material.

Solenysa longqiensis Li & Song 1992

Figs. 12–20

Solenysa longqiensis Li & Song, 1992: 6, figs. 1A–G; Song et al. 1993: 861, figs. 17A–G; Li et al. 1994: 80, figs. 18, 19; Song et al. 1999: 204, figs. 116J, K, Q, R.

Material examined.—CHINA: Fujian: Jiangle County (26.7°N, 117.4°E), Mt. Longqi, Yujiaping Town, 10 August 1991, male holotype, 1 male and 6 female paratypes (IZCAS).

Diagnosis.—The male of this species can be distinguished from all other *Solenysa* males by the bipartite lamella characteristic (Fig. 18) and the peculiarly twisted cymbial apophysis (Figs. 15–17). The female has a somewhat apple-shaped epigynum (Fig. 19), like that of *S. melloteei* (Fig. 29), but distinctly broader apically and the transparent vulval structures are different. Further the solenoid base of *S. longqiensis* is twisted under a triangular cover while that of *S. melloteei* is exposed.

Description.—Total length 1.47, Carapace 0.80 long, 0.50 wide. Abdomen 0.76 long, 0.45 wide. Tm I 0.22. Tm IV absent. Chelicerae with 4 promarginal and 3 retromarginal teeth (Fig. 14). For further measurements and a detailed description of somatic morphology see Li & Song (1992).

Male palp (Figs. 15–18): Tibia slightly longer than patella. Two proximal cymbial

apophysis with twisted bases in dorsal view (Fig. 17). Embolic division (Fig. 18) conspicuously large. Lamella characteristic with two well-developed, ribbon-like branches, apex of first one with a strongly sclerotized claw, second one with truncate, somewhat serrate end. Embolus slightly longer than lamella characteristic. Embolic membrane petale-shaped. Terminal apophysis fist-like. Radix quadrangular.

Epigynum (Figs. 19–20): Apple-shaped, widest close to its anterior edge, about 1.5 times wider than long. Solenoid base about three times as long as the length of epigynum, covered with triangular extension of abdomen.

Distribution.—Known only from the type locality in Fujian Province, China (Map 1).

Solenysa melloteei Simon 1894

Figs. 21–30

Solenysa melloteei [sic] Simon 1894: 677; Oi, 1960: 153, figs. 52–54.

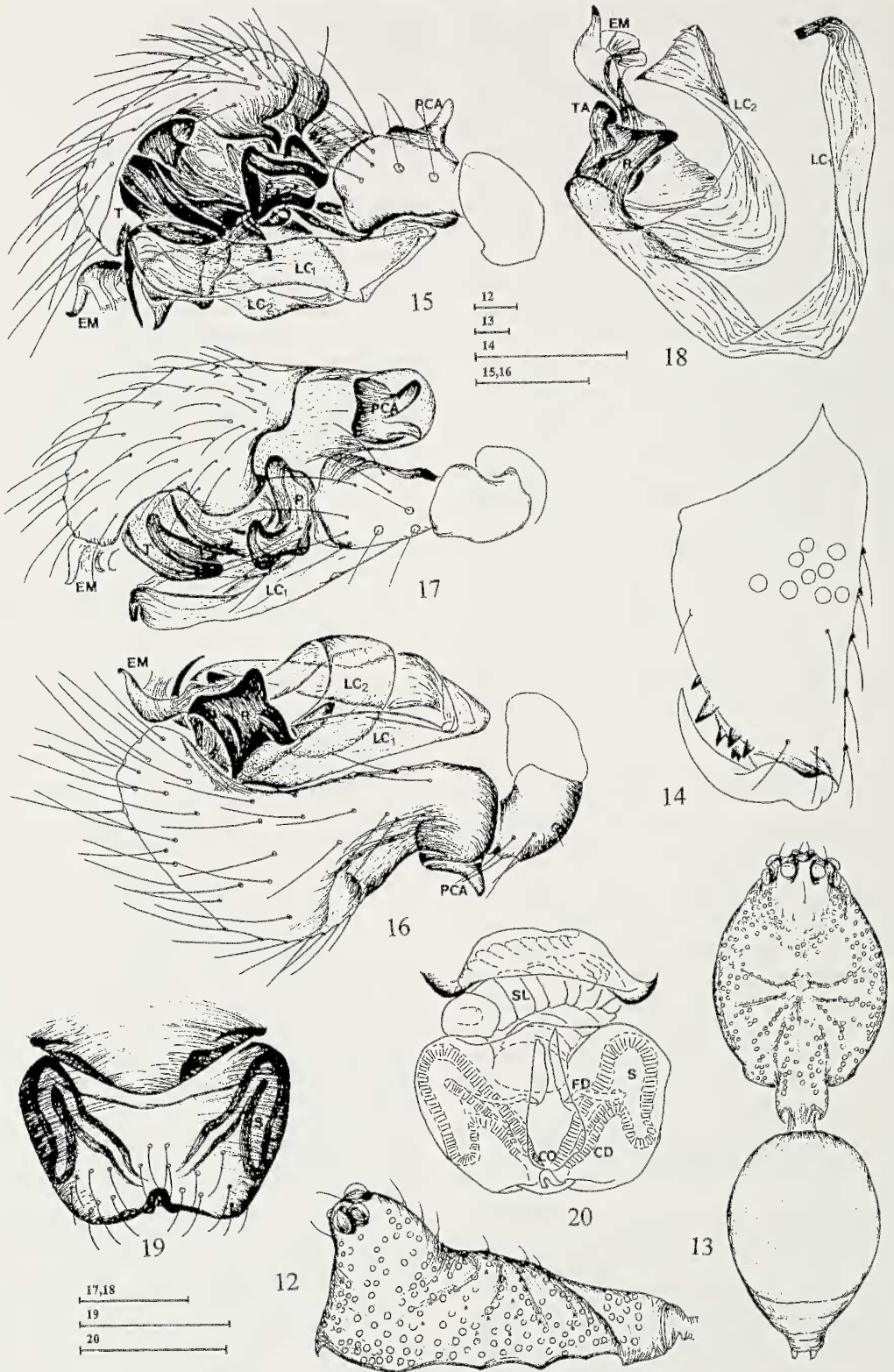
Solenysa melloteei [sic] Simon: Yaginuma 1986: 78, fig. 42.2; Irie & Saito 1987: 23, fig. 21; Chikuni 1989: 56, fig. 48.

Material examined.—JAPAN: no detailed data, 1 male and 1 female (IZCAS).

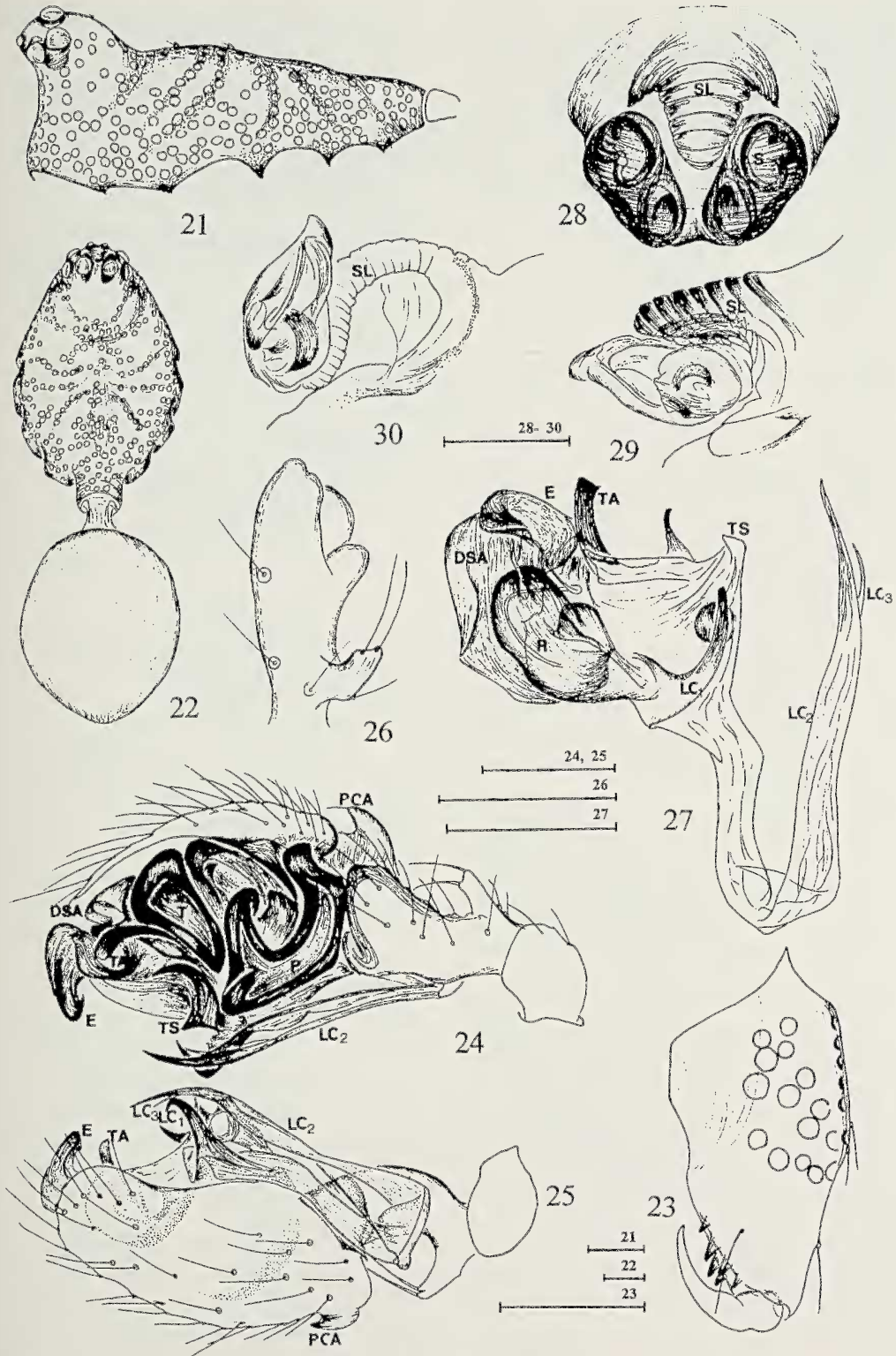
Diagnosis.—The male of this species can be distinguished from all other *Solenysa* males by the broad, coiled embolus and the hook-like cymbial apophysis (Fig. 24). Epigynum (Fig. 28) somewhat apple-shaped, like that of *S. longqiensis* (Fig. 19), but apically narrower and transparent vulval structures of different shape. Solenoid base without cover.

Description.—Total length 1.27. Carapace 0.77 long, 0.45 wide. Abdomen 0.50 long, 0.43 wide. Tm I 0.17. Tm IV absent. Chelicerae with 4 promarginal and 2 retromarginal teeth (Fig. 23). For further measurements and a detailed description of somatic morphology see Oi (1960).

Male palp (Figs. 24–27): Tibia twice as long as patella (Fig. 24), with a dorsal apophysis bearing two long bristles (Fig. 26). Cymbium with a forward pointing, hook-like proximal apophysis (Fig. 24). Lamella tripartite, the first branch short, spike-like and well sclerotized; second one ribbon-like, long and slender, tapering off distally; third one small and thin (Fig. 27). Embolus plate-like, half spiral with a hooked tip (Fig. 24). Embolic membrane indiscernible. Terminal apophysis truncate, with a sickle-shaped dorsal process



Figures 12–20.—*Solenysa longqiensis* Li & Song: 12. carapace, lateral view; 13. carapace, dorsal view; 14. left chelicera, anterior view; 15. left male palp, retrolateral view; 16. left male palp, prolateral view; 17. left male pedipalp, dorsal view; 18. left male pedipalp embolus division, dorsal view; 19. epigynum, ventral view; 20. vulva, dorsal view. Scale bars = 0.1 mm.



Figures 21–30.—*Solenysa melloteei* Simon: 21. carapace, lateral view; 22. carapace, dorsal view; 23. left chelicera, anterior view; 24. left male palp, retrolateral view; 25. left male palp, proteral view; 26. left palpal tibia, dorsal view; 27. left male pedipalp embolus division, dorsal view; 28. epigynum, ventral view; 29. epigynum, lateral view, lifted; 30. epigynum, lateral view, expanded. Scale bars = 0.1 mm.

(Figs. 24, 27). Terminal sclerite triangular, blunt tipped. Radix short, wide and bipartite.

Epigynum (Figs. 28–30): Apple-shaped, widest at its middle, about 1.8 times wider than long. Solenoid base exposed, short, about twice as long as the length of epigynum, and can lift epigynum inversely in nonfunctional stage.

Distribution.—Apparently restricted to Japan (Map 1).

Solenysa protrudens Gao et al. 1993
Figs. 31–39

Solenysa protudens Gao et al. 1993: 65, figs. 1–6;
Song et al. 1999: 204, figs. 116L, M, P, S.

Material examined.—CHINA: *Taiwan*: Taidong (22.7°N, 121.1°E), Lanyu, August 2000–February 2001, 3 males and 2 females (IZCAS). The type material was deposited in JLU but could not be found despite thorough checking of the collection by the authors.

Diagnosis.—The male of this species can be distinguished from all other *Solenysa* males by the stout, erect cymbial apophysis (Fig. 34), petal-shaped embolic membrane and well-developed branches of lamella characteristica (Figs. 34, 35). Epigynum similar to that of *S. circularis*, but more angular with nearly straight sides (Fig. 38).

Description.—Total length 1.67. Carapace 0.83 long, 0.50 wide. Abdomen 0.90 long, 0.50 wide. Tm I 0.22. Tm IV absent. Chelicerae with 4 promarginal and 4 retromarginal teeth (Fig. 33). For further measurements and a detailed description of somatic morphology see Gao et al. (1993).

Male palp (Figs. 34–37): Tibia nearly twice as long as patella, with small dorsal process bearing two long bristles (Fig. 34). Cymbium with a stout and erect proximal apophysis, pointing dorsally. Lamella characteristica tripartite (Fig. 37), the first and third branches sword-shaped, robust, well-sclerotized, the latter longer than the former; the second ribbon-like, with denticles on its distal end. Embolus slightly longer than lamella characteristica. Embolic membrane petale-shaped, with two processes. Terminal apophysis small, triangular (Fig. 37).

Epigynum (Figs. 38, 39): Rectangular, about three times as wide as long. Solenoid base about three times as long as the length of epigynum.

Distribution.—Known from China (Jiangsu, Taiwan) (Map 1).

Solenysa wulingensis Li & Song 1992
Figs. 40–46

Solenysa wulingensis Li & Song 1992: 7, figs. 2A–E; Song & Li 1997: 404, figs. 6A–E; Song et al. 1999: 204, figs. 117A, B.

Material examined.—CHINA: *Hunan*: Zhangjiajie National Nature Reserve (29.1°N, 110.4°E), Dayong City, 13 August 1990, male holotype and 2 male paratypes (IZCAS).

Diagnosis.—The male of this species can be easily distinguished from all other *Solenysa* males by the rudimentary cymbial apophysis (Fig. 45). The female is unknown.

Description.—Total length 1.40. Carapace 0.80 long, 0.50 wide. Abdomen 0.67 long, 0.45 wide. Tm I 0.19. Tm IV absent. Chelicerae with 4 promarginal and 3 retromarginal teeth (Fig. 42). For further measurements and a detailed description of somatic morphology see Li & Song (1992).

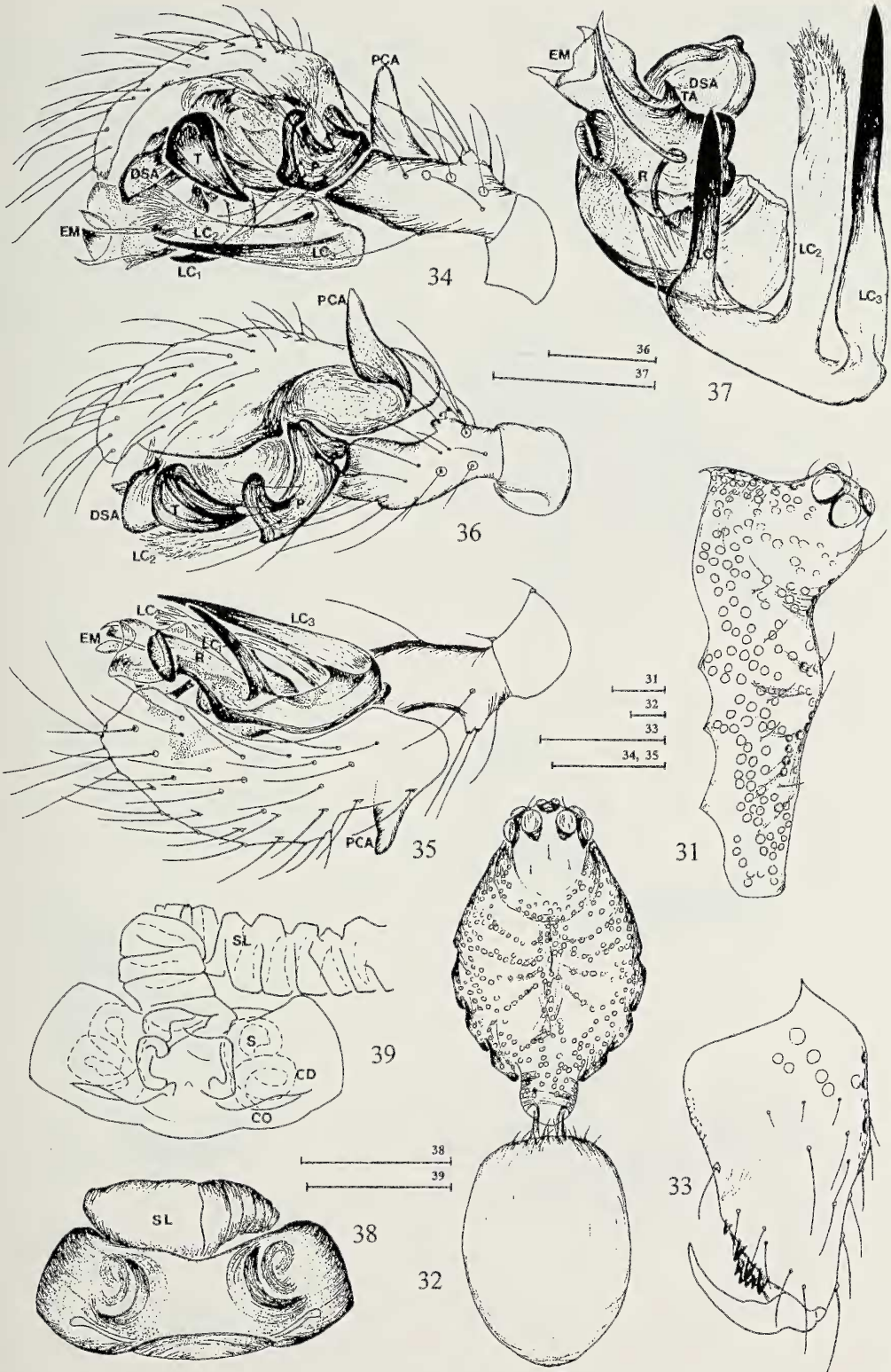
Male palp (Figs. 43–46): Tibia slightly longer than patella. Cymbial apophysis small, nearly inconspicuous (Figs. 43, 45). Paracymbium strongly curved at its middle, proximal end with small lateral curvature. Lamella characteristica tripartite (Fig. 46), first branch spike-like, well sclerotized, second one largest, ribbon-like, tapering off distally, third one small, thin. Embolus (Fig. 46) short, embolic membrane flower-shaped. Terminal apophysis with two apical and one median process. Terminal sclerite foliaceous. Radix elongated, blunt tipped.

Female: Unknown.

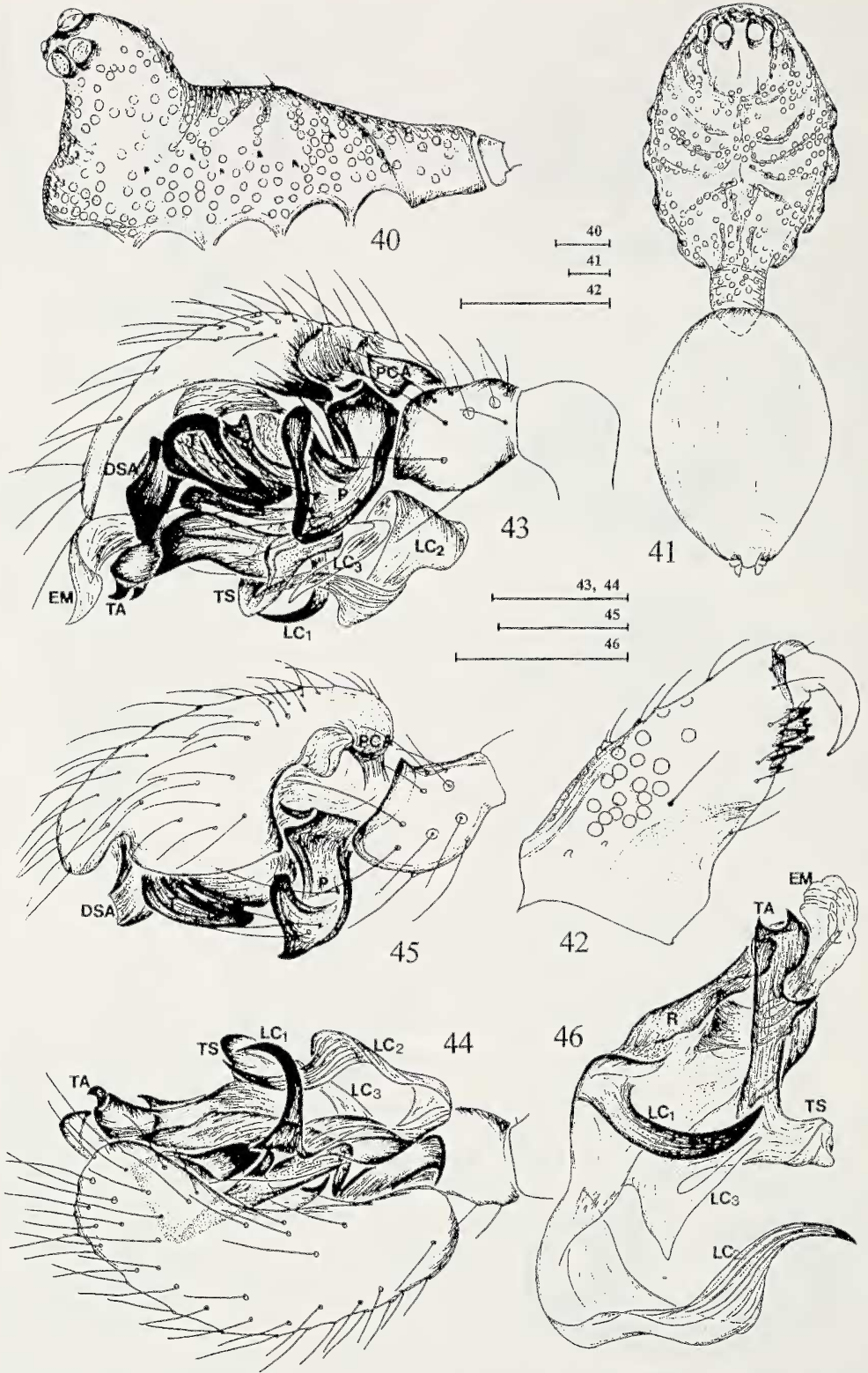
Distribution.—Known only from the type locality in Hunan Province, China (Map 1).

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Figures 31–39.—*Solenysa protrudens*: 31. carapace, lateral view; 32. carapace, dorsal view; 33. left chelicera, frontal view; 34. left male palp, retrolateral view; 35. left male palp, prolateral view; 36. left male palp, dorsal view; 37. left male palp embolus division, dorsal view; 38. epigyne, ventral view; 39. vulva, dorsal view. Scale bars = 0.1 mm.



Figures 40–46.—*Solenysa wulingensis* Li & Song: 40. carapace, lateral view; 41. carapace, dorsal view; 42. left chelicera, anterior view; 43. left male palp, retrolateral view; 44. left male palp, prolateral view; 45. left male palp, dorsal view; 46. left male pedipalp embolus division, dorsal view. Scale bars = 0.1 mm.

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